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Goleta Bay Kelp Forest Re-establishment and Beach Sediment Study

**A Group Project Proposal to the Donald Bren School of
Environmental Science and Management, University of
California, Santa Barbara**

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This Project Proposal Sponsored By:



Beach Erosion Authority for Clean Oceans and Nourishment

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Background

(Photos courtesy of Robert Kiel)



Goleta Point looking east, (in the direction of Goleta Beach) 1975.

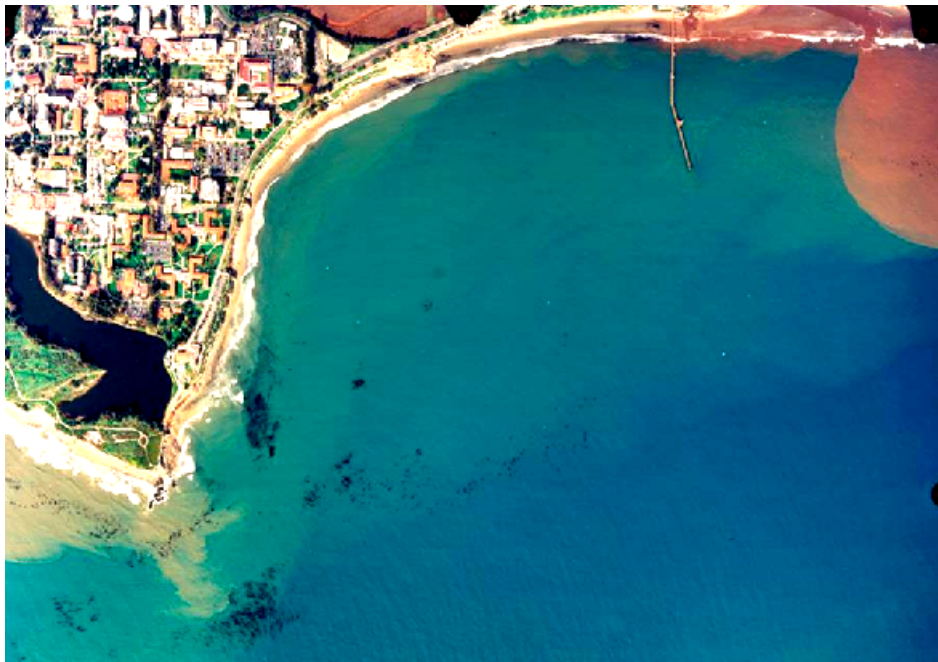


Goleta Point looking east, 2001.

Clearly something fundamental has changed. The established vegetation in 1975 shows that the wide beach was a relatively stable condition.



Kelp forest in Goleta Bay, 1972. *Pacific Western Aerial Surveys*



Goleta Bay at present. *Pacific Western Aerial Surveys*

Introduction

There was once a large-scale kelp (*Macrocystis pyrifera*) forest covering much of outer Goleta Bay which may have extended all the way to the Santa Barbara harbor. Kelp beds along the Santa Barbara coast were historically able to develop on sand substrates as opposed to rock reef, a condition unique to Santa Barbara. Most of these sand-based kelp beds were destroyed by the higher water temperatures and storm turbulence during the 1982-83 El Niño winter and have not been able to re-establish themselves. There has been a corresponding erosion of the beach and narrowing of the beach width along Goleta Bay to the point that the Goleta Beach Park facilities are threatened. Correlation between the two is uncertain, but it presents an intriguing possibility.

Significance

Kelp provides important habitat for numerous marine organisms, including sport fish species. Kelp beds are particularly important when established on sand substrates, which are otherwise relatively unproductive biologically. Kelp forests act as a carbon sink, add dissolved oxygen to the surrounding water, and can dampen wave action and wind-driven currents. The sand-based kelp forests off Santa Barbara are a unique and increasingly scarce ecosystem and have traditionally supported commercial and sport fishing, kelp harvesting, and recreational activities such as SCUBA diving. For these advantages alone, and for the scarcity of sand-based kelp ecosystems, the re-establishment of a large-scale, sand-substrate kelp forest would be of significant ecological and economic benefit.

Moreover, the re-establishment of this particular kelp forest in Goleta Bay could have significant positive impact on the stability of the beaches from Goleta Point through Goleta Beach Park. As shown in the photos, the beach has narrowed dramatically since the kelp forest disappeared in the early 1980's (largely due to the 1982-83 El Niño storms). Beach erosion at the Goleta Beach Park has become a critical issue. On several occasions erosion due to storm conditions and high tides have threatened the park itself; Santa Barbara County has responded by placing rock revetments to protect park lawns, picnic tables, parking lot, and utilities. Numerous community and environmental groups have challenged the rock revetments, and on one occasion a portion revetment was removed, only to be replaced again under emergency conditions when a subsequent storm threatened the park. The county has applied to the California Coastal Commission for a two-year permit to leave this emergency revetment in place while a master planning process is undertaken to develop a long-term plan for the park. A working group comprised of more than a dozen stakeholder groups began meeting in December 2003 to attempt to reach a consensus and submit recommendations to the board of supervisors. Meanwhile, an approximately \$2 million dollar sand re-nourishment project was undertaken by BEACON in October 2003 to stabilize the beach before the 2003-2004 winter season. Sand was dredged onto barges from near Santa Barbara Harbor, piped from the barges to the beach, and pushed up and spread out on the beach with bulldozers. Further opportunistic sand nourishment will continue to be pursued, for example when Santa Barbara Flood Control removes sand from the Goleta Slough it will

A March 2002 report by Moffatt and Nichol Engineers commissioned by the Santa Barbara County Parks Department recommends that if beach nourishment alone is not sufficient, Santa Barbara County Parks should investigate the construction of offshore breakwaters to dampen swell energy and help retain sand (Attachment 1). As the figure shows, the rock breakwater proposed is in a position clearly covered by the historical kelp forest and there is a chance that a re-established kelp bed could perform the same function at a lower cost and simultaneously provide significant ecological services.

Studies have shown that while kelp beds effectively dampen short-period wind chop and wave energy, long period wave energy is able to pass through relatively undiminished (Elwany, et al., 1995). Long period wave energy associated with offshore storms is cited as the primary source of beach erosion at Goleta Beach, so it is possible that an offshore kelp bed would have little effect on beach erosion related to storm events. However, there is still a large degree of uncertainty with regard to the effect of offshore kelp beds (especially in a semi-confining situation such as Goleta Bay) on beach width and erosion. Strong low-pressure storms that move over the area have a mix of long and short period wave energy, both of which cause beach erosion; thus at least part of this energy would be dampened by a kelp bed. There the additional possibility that the kelp bed could encourage deposition of sand migrating offshore even if failing to stop waves from coming to the shore; creating a subsurface 'dune' similar to dune fencing along sandy roads or snow-drift fences along highways. If so, it would decrease the slope of the sand between the beach and the kelp bed leading to less impetus for erosion. A measurement of bottom slopes inside and outside of sand-based kelp beds could be undertaken to test for a correlation. This is a particularly significant question at Goleta Beach because the opportunistic sand nourishment program undertaken by BEACON will be placing large volumes of new sand on the beach and means to slow its removal from the immediate area would be beneficial.

Beyond Goleta Bay, the successful re-establishment of a large-scale kelp bed on sand substrate would have interest throughout Southern California. The BEACON area of responsibility extends along a large stretch of coast from Santa Barbara through Ventura and if successful, the project could have applicability to the entire region. There is considerable uncertainty surrounding the feasibility of artificially establishing sand-based kelp beds and their possible effects on beach width and erosion, which hampers decision-making around issues such as Goleta Beach Park. Reducing such uncertainty would provide an important contribution to coastal policy decisions in the future.

Objectives

The objectives of the group project are to study the potential benefits of re-establishing the Goleta Bay kelp bed, and investigate the feasibility of doing so. Concurrently, Professor Griggs and Ph.D. candidate David Revell from the University of California at Santa Cruz will embark upon a two and a half year study to evaluate the beach widths and sediment budget from the Santa Maria River south around Point Conception to Pt. Magu (Santa Barbara Littoral Cell). A pilot project has been proposed to study the long-term beach changes and storm events along the Isla Vista shoreline (Coal Oil Point to

Goleta Beach). An objective of the Bren group project will be to collaborate with Griggs and Revell on the shoreline study. The UCSC study will rely largely on historical aerial imagery and remote sensing techniques. This study proposes to determine if any historical correlation can be established between the presence or absence of offshore kelp forests and beach width. Specific questions for the Bren group project include:

- Is the re-establishment of the Goleta Bay kelp bed ecologically desirable? (literature review, Department of Fish and Game consultation)
- Why hasn't the kelp bed re-established itself over the last twenty-plus years? (literature review, potential field studies, Goleta Bay sea floor survey and photo-documentation, etc.)
- Is re-establishment feasible? What would it cost? (literature review, follow-up Kelco, Inc. studies including field surveys of kelp bed re-establishment sites and documentation of current state)
 - What are the most promising techniques for soft-sediment kelp re-establishment?
 - What are the sea-floor conditions in the proposed area? Are *Macrosystis* plants present? What is the size and density distribution? (field documentation)
 - Is there any pilot study that could be undertaken to test different techniques within the project time frame?
- What are the long-term trends in kelp growth in Goleta Bay? (historical aerial imagery and remote sensing analysis)
- What are the long-term trends in beach width and sediment transport along Isla Vista and Goleta Beaches? (historical imagery and remote sensing analysis, UCSC study)
- Is there a causal relationship between the presence of kelp and beach stability in the Santa Barbara region? (literature aerial imagery and remote sensing analysis, possible field studies)
- Is there any evidence that re-establishing the Goleta Bay kelp bed would increase sand deposition on Goleta Beach or aid in retaining sand from beach re-nourishment efforts? (literature review, aerial imagery and remote sensing analysis, possible field studies)

Several specific field experiments and pilot studies have been proposed to answer some of these questions and details are available upon request. However, this is a dynamic proposal and specific methods of project execution and field studies should be developed with the full master's project group and with Bren School and UCSB faculty input, BEACON staff, Robert Kiel, and Prof. Griggs and David Revell from UCSC.

Additionally, there are a wide variety of research and professional resources available to support the project. For instance, Kelco, Inc. (now ISP Alginates, Inc.) conducted research under contract to the DFG regarding establishing soft-sediment kelp beds during the 1980s, but conclusions have not been published. If there has been no follow-up to these attempts, the kelp establishment sites should be surveyed and current conditions recorded. Robert Kiel with the Seattle Aquarium has conducted research and proposed a method for distributing anchors for *Macrosystis* to colonize. Kiel has applied for a permit from the California Coastal Commission to deploy 24 test anchors in the spring of

2004 as a pilot study. Should the permits be granted, the Bren group can deploy, survey, and monitor the anchors throughout the year for *Macrosystis* colonization and anchor behavior on the sea floor. BEACON has agreed to provide professional advisory support to the project. Griggs and Revell will be invaluable resources in analyzing beach and sediment transport processes.

Deliverables

Deliverables will include a final report to BEACON assessing the feasibility of re-establishing the Goleta Bay kelp forest, and will include conclusions drawn regarding beach sediment processes and the potential impact of a kelp bed on such processes. This report will be linked to the Goleta Beach website to help inform the public process. The report will include a summary of the literature review and follow-up to previous kelp establishment studies, GIS analysis of historical imagery, data from field studies conducted in support of the project, and photographs of the Goleta Bay sand substrate and kelp colonization documentation (on natural and/or introduced structure). Additional deliverables may be negotiated to support the sedimentation study conducted by Griggs and Revell. The final report and project data will be made available to the County of Santa Barbara, the California Coastal Commission, the California State Lands Commission, the U.S. Army Corps of Engineers, California Department of Fish and Game, and local and state community groups.

Support

Two student internships for spring and summer 2005 funded through the Shoreline Preservation Fund. (\$10,000).
Funding for group members to support the UCSC Santa Barbara Littoral Cell sediment study. \$3,000 (funding has been applied for but not yet granted).
Project expenses, field supplies, etc. (Community Environmental Council; \$3,000 applied for).

References

California Department of Fish and Game, *Artificial Reef Plan for Sport Fish Enhancement*, 1990.

Elwany, O'Reilly, Guza and Flick. 1995. *Effects of Southern California Kelp Beds on Waves*. Journal of Waterway, Port, Coastal and Ocean Engineering. Vol. 121, No. 2.

Goleta Beach Master Planning Process (and related links).
www.sbparks.org/goletabeach.

Kelco Division of Merck & Co., Inc., August 1990. *Final Report, Santa Barbara County Kelp Restoration in Sand Habitats*.

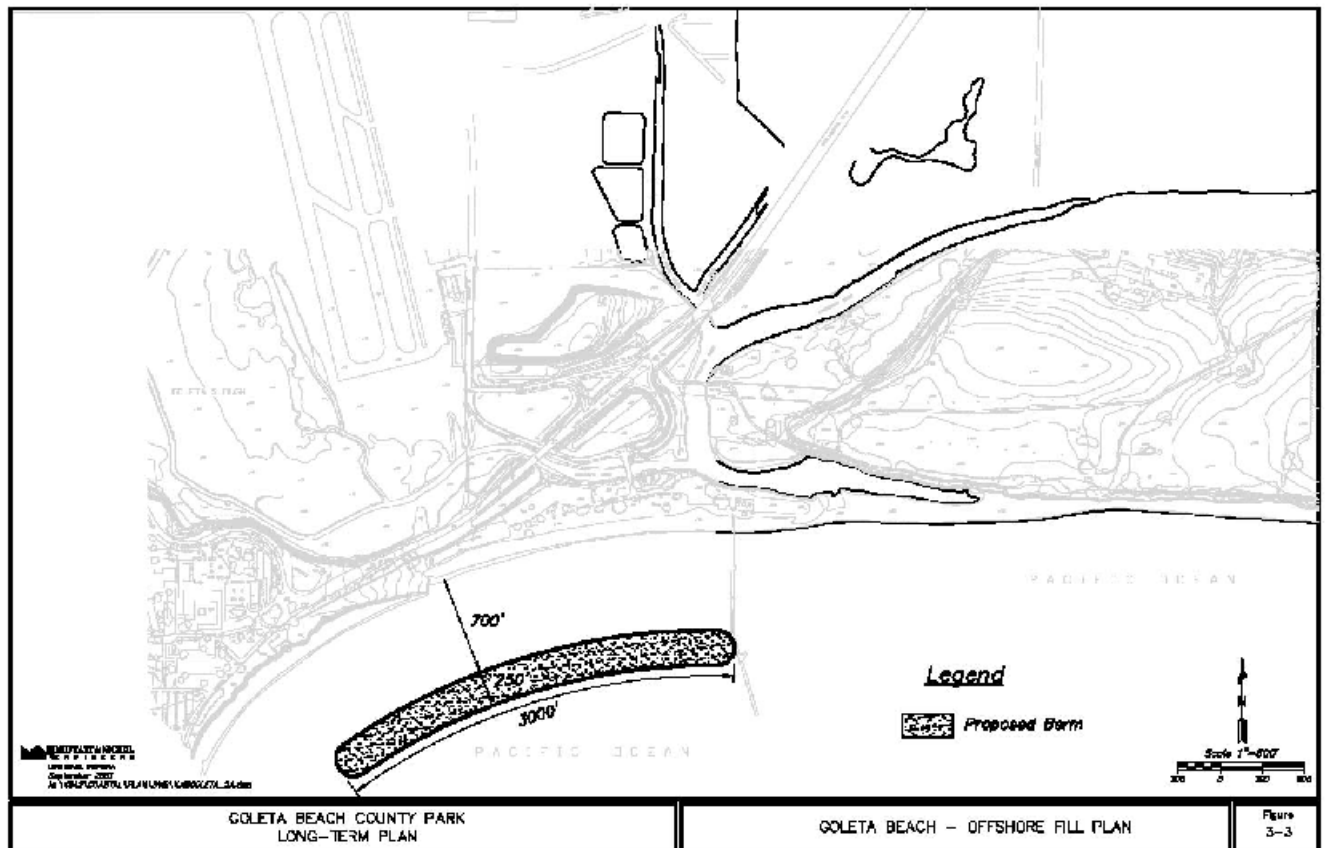
Kiel, Robert. November 2003. *Goleta Bay Sand-Based Kelp Bed Reestablishment*.

Moffatt & Nickol Engineers. March 2002. *Goleta Beach County Park Long-Term Beach Restoration and Shoreline Erosion Management Final Plan*.

This proposal was developed in consultation with:

- Karl E. Treiberg, Environmental Planner, Santa Barbara County Flood Control and Water Conservation District and BEACON member
- Rachel Couch, Santa Barbara County administration
- Scott Bull, Shoreline Preservation Fund and Goleta Beach Working Group representative
- David Revell, PhD candidate University of California at Santa Cruz
- Dan Reed, Marine Science Institute, University of California at Santa Barbara
- Hunter Lenihan, Bren School, University of California at Santa Barbara
- Mark Holmgren, president, San Marcos Foothills Coalition
- James To, UCSB Service Learning Program
- Mark Kram, Bren School Research Faculty
- Bob Keats, Surfrider Foundation
- Jill Komoto, Community Environmental Council
- Robert Kiel, Seattle Aquarium and author of *Goleta Bay Sand-Based Kelp Bed Re-Establishment Draft Proposal*, dated November 11, 2003

Attachment 1



From Moffatt & Nickol Engineers. March 2002. "Goleta Beach County Park Long-Term Beach Restoration and Shoreline Erosion Management Final Plan".

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